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This research summarizes the results of a study carried out by Cirad in 1998 fro the World Bank : " Study on the indicators for a field evaluation of Integrated Pest Management Training Programme in Indonesia " . World Bank staff collaborated in some steps of the study

Abstract

Integrated pest management, a cropping production practice that provides for a healthier crop, less human health problems and better environment based on the use of alternative pest control methods, observation and rational use of pesticides, is a knowledge intensive technique. Indonesia implemented a state policy to promote the use of this technique, specially in rice. One of its components was the training of farmers. Farmers Field Schools, a participatory approach to learning, was the method chosen for the training. After several years, it is observed that Farmers Field Schools were very succesful in sharing the IPM principles with the farmers participating in the program, but that they had a low impact on the other farmers.

Keywords

Project evaluation, Integrated Pest Management, Environment, Technology transfert, Policy

Introduction

Integrated Pest Management, a crop management concept that requires to recognize pest and beneficials, to observe their interactions, to use pesticides carefully and rationally and to apply alternative control methods, results in healthier crops, less human health problems and a better environment. However, implementing IPM principles in the field is not easy. It implies a strong change in production practices and the lack of knowledge of its impacts generates a degree of uncertainty that farmers might not be ready to confront in the actual context. Therefore, if IPM is to be broadly used, there is a need of a combination of factors to succeed its broadcasting and acceptation: research, field experimentation, transmission of knowledge, policies.

In Indonesia these factors have been implemented because of some serious drawbacks experienced when applying the linear "top-down" extension model to generalize the Green Revolution package. Even if this technology enabled the country to move from a situation of chronic shortages of rice to a capacity to feed its population, and ultimately to become self sufficient in rice production, some problems were observed: the mid- 1986 massive outbreak

of Brown Plant Hopper (BPH), resulting in a loss of 75000 ha of rice in Central Java; the resurgence of BPH resistance to a number of pesticides (Oka, 1991). Some of the reasons given to explain this attack were the lack of use of BPH resistant varieties and the excessive use of pesticides.

Therefore, the presidential Decree N°6 1986 was issued outlining the following principles : the type of insecticide used and the method of application had to take into account the protection of natural enemies of the BPH and other insects species of rice ; the development of insect resistance to insecticides had to be avoided through insecticide resistance management ; and insecticide were to be used only if other control methods are not effective, and then in a judicious way. To achieve these goals the decree further stated : the knowledge and skills of crop protection field personnel should be improved ; results of field observations by this personnel should determine pest management recommendations to farmers ; agricultural extension officers should provide information for farmers based on directives laid down by crop protection field personnel in such a way that farmers are aware of correct pest control and are ready and able to practice it ; and agricultural extension officers, farmers' groups and farmers should be trained to increase their skills (Oka, 1991). Hence IPM being a national priority, the Government of Indonesia implemented the following components: 1. IPM research support, 2. IPM Policy (ban of pesticides, tolerance degree of pesticide in agricultural policy), 3. Structural Changes (pesticide commission, environmental assessment), 4. Institutional arrangements and 5. Follow up activities.

Several pesticides were therefore banned for use in rice crop and the implementation of Integrated Pest Management Training Program (IPM/TP) was decided, first with funds provided by a grant of USAID and latter through a loan from the World Bank, with the technical assistance of the Food and Agriculture Organization (FAO). The program started in May 1989, with an establishing phase that ended in 1992 and a first implementation phase that ended in August 1999.

Many evaluations have been carried out on IPM farmers (Pinkus, 1991, Oka 1991, Dep Tan, 1993; Winarto 1995, Rubia et al. 1996, FAO 1998) and on several aspects of FFS (FAO 1995, Dilts and Hate 1996, Ooi 1996, Braun 1997, FAO 1998). In this paper only the field impact of IPM/TP is analyzed. First the program will be presented, second the outcome of the program will be summarized, third the broadcasting of the effects will be analyzed, and finally, some conclusion will be drawn.

The Integrated Pest Management Training Program and the implementation of Farmers Field Schools

The Integrated Pest Management Training Program in Indonesia has three main components : i. sensitizing farmers to Integrated Pest Management (IPM), ii. training of farmers to become trainers to disseminate the principles of IPM and iii. training of pest observers. The first component was mainly implemented through a Farmer Field Schools (FFS) program. The second one consisted in the training of pest observers and farmers to carry out FFS sessions. The third was a national training program of pest observers to become pest experts and give recommendations on pest management.

FAO (1998) indicates that "*FFS has at least 4 components: agro-ecosystem observation, analysis and presentations, special topics and group dynamics. Their impacts can be observed at four levels: healthy crop, conservation of pests' natural enemies, conducting of regular field observations and farmers becoming IPM experts. Besides, other effects are extremely important: farmers role vis à vis IPM activities, farmers relationships with their context, and the achievement of conditions under which farmers have the opportunity to develop their potential*".

Several hypotheses lie behind the FFS principle: farmers need to become their own "specialists", "extension agents" and "researchers", providing the impetus for change, instead of the usual top-down extension methods or "linear paradigm", where recommendations are given and farmers apply them without fully understanding the causes and the impacts. The rice field becomes the field laboratory where FFS participants learn about the ecology of the rice field by means of regular observation and analysis of field conditions.

This learning method is based on a participatory process: i. the process emphasizes making decisions and taking actions based on group discussion and analysis, participants have thus the opportunity of enhancing both ecological and social dynamics; ii. once the farmers have understood the reasons for applying a technology, they can explain to other farmers the concept, show them the results and then the knowledge will spread spontaneously. The increasing understanding of participants regarding social dynamics enables farmers to develop collaborative efforts to ensure that planned actions are implemented.

Another impact of FFS might be the "empowerment" of farmers, who become "critical" to a top-down extension service, relate differently to other farmers, make group decisions, etc. The goals of a community-based program are ambitious and aimed at making the community a stronger constituency. Such a program reaches to the core values of the farmers' group and

proposes to establish a new form of community organization that will put the needs of the largest segment – farmers - at the highest level of priority (Hammig, 1998).

In Indonesia Farmers Field Schools (FFS) were conducted either by a Pest and Disease Observer (PHP) or by a Farmer Trainer. A PHP is an employee of the Indonesian Directorate for Crop Protection who has received a year long intensive training on IPM. Farmer trainers are peasants who, after having participated in FFS, have followed a one week long "Training of Trainers" process, mainly on leadership, facilitation and ecology (FAO, 1998).

Follow up is also an important component of the FFS process. Several activities are carried out for FFS alumni: another crop IPM training (soybean and vegetables), follow up of Field Schools (to increase farmers' skills in program planning and the implementation of field studies), farmers' planning meetings and Farmers' technical meetings (to involve alumni in a cross-village network of farmers concerned about IPM) and area planning workshops (to provide alumni with an opportunity to develop their planning skills as well as to plan out their own farmer-led community IPM programs.

What is the impact of this technique of transmission ? The effect at the level of crop health (the intensity of pest attack, use of resistant varieties, level of pesticide use, etc.) can be easily estimated. The "sociological" changes consequent of the training are much more difficult to estimate because its components are related to changes in attitudes and behaviors. There are also other effects that should be considered: better human health; lower environmental damages; farmers' empowerment; and finally crop costs and yields and their impact on farmers' profits.

A field evaluation

To analyze the impacts and according to the hypothesis of FFS, the differentiation of farmers should happen at least at two levels: first, farmers who have participated should apply the IPM principles; and second, farmers who have not participated in FFS but belonging to a village where FFS took place might also have adopted the IPM practices in contrast to farmers who have never heard of IPM.

To capture and analyze these differences, it was decided to carry out a survey of a sample of 400 farmers belonging to each of these groups as well as those from villages where no FFS ever took place in order to compare the results. The non FFS villages had to have similar characteristics to the FFS villages. Farmers where chosen randomly from a list of farmers obtained form the Pest observers and/or from the village officers. It also appeared necessary to evaluate the influence of agro-ecological and economic characteristics in the process of

adoption. Thus two important rice production regions with different water availability, irrigation system, topography, socio-economic and production structure were chosen: the West and the East provinces of Java.

A questionnaire was elaborated stressing the following aspects: the structure of production; rice cropping patterns; relationship between the use of chemicals and the health problems and the environment; spill over of the IPM knowledge; and some aspects related to the Training of Trainers (TOT) program. The survey was carried out in an unstructured way very similar to the Rapid Rural Appraisal techniques, to reduce conformity bias.

Two type of analysis were carried out: first, the test of relevance of the differences between farmers who had participated in FFS and those who had not, through the use of cross tables and a significance analysis (test of Chi-Square). Second, a Correspondence Analysis, to verify the similarities and differences between groups to identify the variables that define these differences and to test the transmission of knowledge of the IPM practices from those who have participated in the training to those who have not.

Comparison between groups

The analysis confirms a strong difference between agro-ecological and economic regions, which affects farmers behavior. In the East farmers appear to be more oriented to agricultural activities, in the West they are also concern by the off-farm activities.

The group of farmers who participated in FFS appear to have been chosen with some specific characteristics: young, with higher education and better equipped (hand tractor). These characteristics may imply a possible selection bias of the training towards the most receptive farmers. Also, a higher proportion of trained farmers appear to participate in group activities, which was one of the goals of IPM/TP.

Concerning crop management, trained farmers appear to use more insect-resistant varieties, which evidently affects the use of pesticides and the production cost; to apply higher doses of fertilizer, specially Super Phosphate; to spray less against pests, and when they do, the decision has to be based mainly on insect count and/or during outbreaks; to use alternative management to increase control, like cropping patterns, botanical insecticides, crop rotation, periodic draining, stubble management, conservation of beneficials, etc.; and to identify better the pests, pest damages and specially beneficial insects. Some of these characteristics appear to be more intensive in West Java, were the level of infestation is higher, which might explain the higher degree of adoption of the IPM message. Also, more trained farmers appear to seek external advise from different sources. The only problem emerging form the survey is related

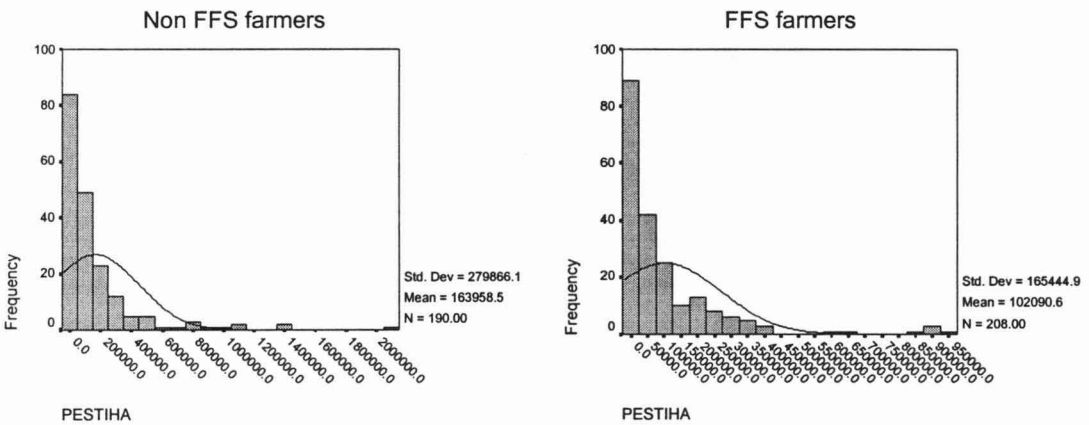
with the lack of advice in terms of pesticide choice and use during outbreaks, or when pest densities are above thresholds. In these occasions, trained farmers use the same range of pesticides, banned or not, than the untrained ones.

Farmers who participated in the program appear to be more aware of the problems generated on the environment of the use of pesticides : less fish in the river, health problems, etc. They employ safer techniques to dispose of pesticides containers.

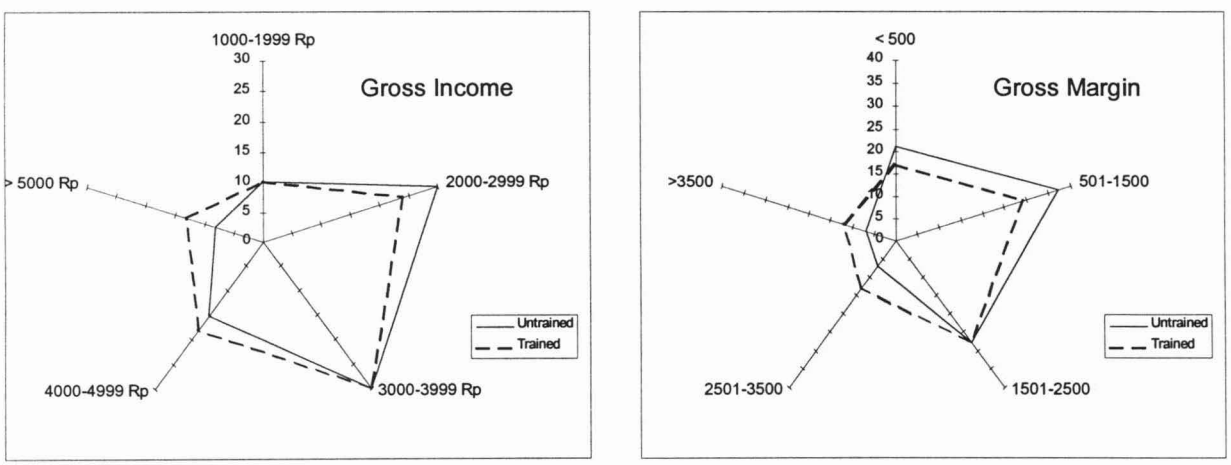
Also farmers declare that IPM had an impact at the economic level, with healthier crops and more interaction with other farmers.

All this is confirmed by the comparison of costs and benefits: lower cost of pesticides (Graph 1), less employment costs, and against expectations, lower fertilizer costs. The gross income is higher in the average and more trained farmers have higher gross income and gross margin (Graph 2).

Graph 1: pesticide cost for rice per ha.



Graph 2: percentage of the farmers for each class of gross income and of gross margin (1000 Rp)



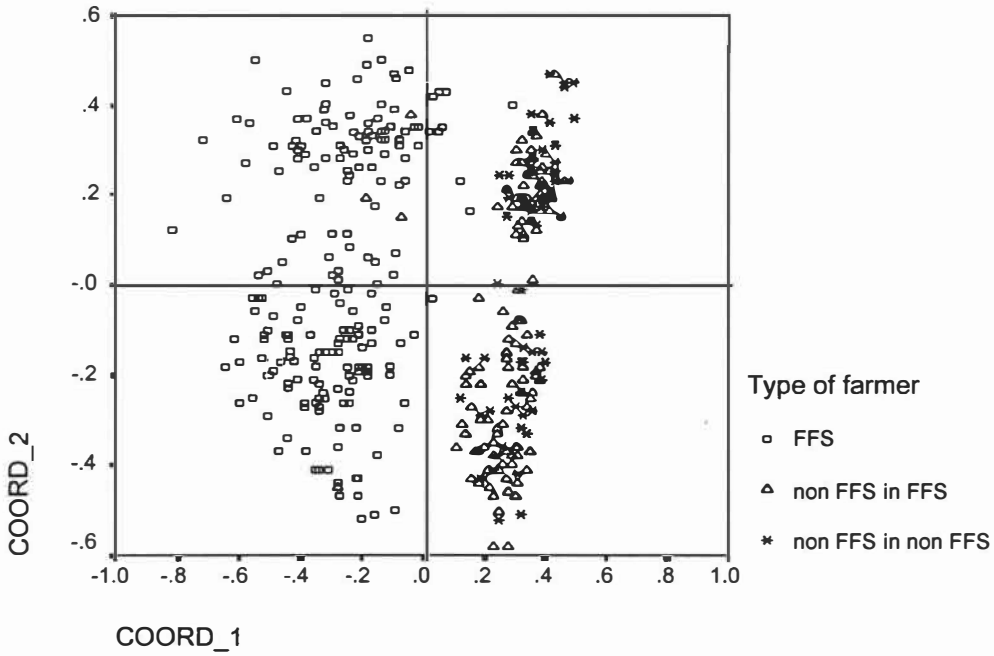
The differences of gross margins among untrained farmers as a function of belonging or not to an FFS village is significant but without a clear trend on which is higher, which might imply a low degree of adoption of IPM.

Similarities between groups and transmission accomplishment

All these results indicate a difference between farmers according to their participation in FFS, but it appeared relevant to improve the analysis through the use of statistical methods that could enhance the comprehension of the differences between the groups. The Correspondence Analysis is a statistical tool that can be used to indicate the statistical similitude between individuals according to their responses for each variable. It is based on the minimization of the euclidean distance of the value of each variable of each individual in the sample to group them in the space according to the similarities. Thus it is possible to represent in the space a cloud of dots that summarize the individual characteristics and the degree of similitude among individuals. All the variables for this analysis have to be qualitative, which implies that the observed values have to be coded in different categories (or classes) according to the frequency of responses observed for each variable. The axis in the graphs are used to represent the contribution of each variable to the explanation of the axis. Through the analysis of the variables that contribute the most to the definition of the axis (coord 1 and 2 in the graphs that follow), it can be understood the "meaning" of each of the axis.

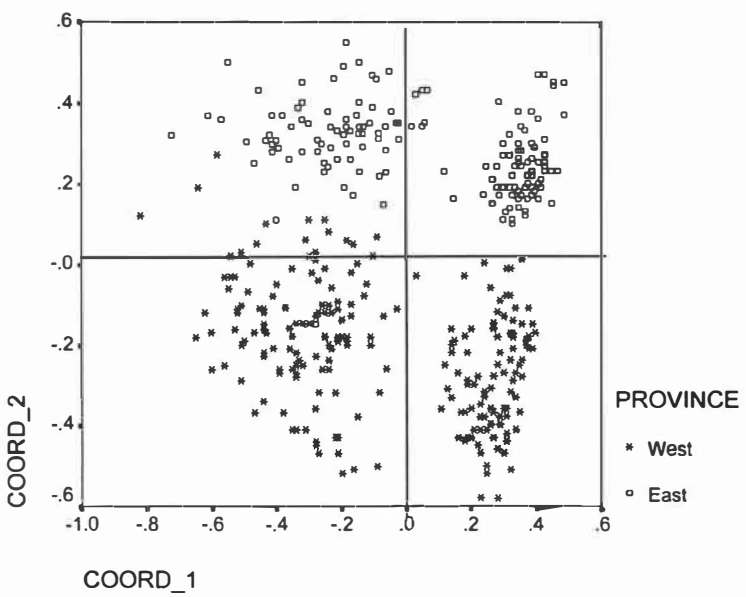
In the representation of our sample, the first two components express 9.88% of the variance among individuals. Graph 3 shows that there are 2 main "clouds" of individuals: on the left hand side are scattered most of the individuals having participated in FFS, on the right hand side are most of the untrained farmers, but forming two different groups, one in the first quadrant and another in the second, difference that not associated with belonging to a FFS village. This might indicate that the spill over of IPM training towards farmers in the FFS villages has not yet been achieved.

Graph 3: Representation of all farmers



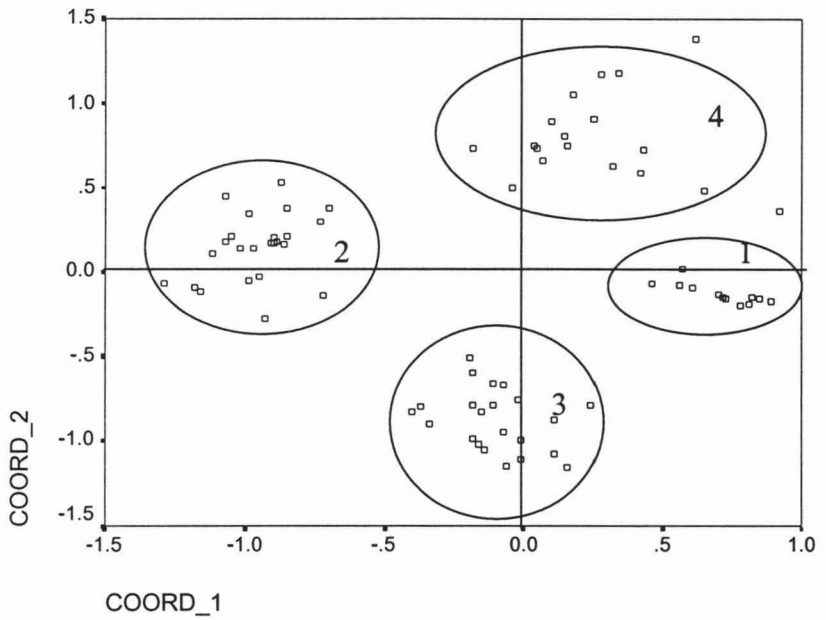
The difference between untrained farmers is due to their location. As shown in graph 4, this last factor appears to be the most determinant: all East Java farmers are located in the top half of it, the West Java farmers in the middle and bottom half of the graph. Thus, it can be confirmed through the analysis of all these representations that FFS farmers in both provinces are located in the left hand side of the graph, *the "FFS space"*; and non FFS farmers in both regions (belonging or not to FFS villages) are in the right hand side of the graph, *the "non FFS space"*. The transmission of knowledge however appears to be very low, due to the strong difference between trained and untrained farmers and the lack of difference between untrained farmers.

Graph 4: Projection of farmers according to the province.



However FFS farmers might not form a homogeneous group because they are scattered in both the 3rd and 4th quadrants. The differences might be due to the location of the farm, to differences in the training process or to structural differences. To improve the understanding, the meaning of each component has to be identified. It is necessary then to analyze the variables that participate in the construction of each component. To do this, the codes of variables whose contribution to each pair of axes was higher than 0.8 were represented in the space (Graph 5). Four well defined clouds of points can be observed: two at the extremes of the horizontal axis (n° 1 and 2) and two in the extremes of the vertical axis (n°3 and 4).

Graph 5: Representation of the variables in the first two components space.



The first component can be associated with the technological level of farmers. In group 1 are coded the traditional production systems, implying a lack of knowledge on practices associated to IPM. On the other side of the axis, group 2 is formed of the codes of variables associated with IPM and also with FFS participation: farmers completely participated (1 or 2 sessions) to FFS, would like to have more FFS, carried out follow up activities, communicated the learning to other farmers, use IPM practices taught in FFS (resistant varieties, rational use of pesticides, cultural practices), interacted with other farmers and participate to farmers groups, are aware of having healthier crops, and even if IPM requires more work, are convinced of having a better economic result. This group of variables is closely associated with having been trained by pest observers; "other type of trainer" (mainly the extension agent) and farmer trainers (TOT) are included in this group, but not very close to the center of the group. This is logical because a strong proportion (85%) of farmers in the

sample were trained by PHP and also because there might be differences in the training according to the person in charge of it.

The second component is more linked with the production structure and, apparently, the attitude towards agriculture. This is strongly linked with location of the farmers and the agronomic characteristics of each province. The group 3 is characterized two cropping seasons (mainly rice), farmers live in the farm and migrants collaborate to the activities in the farm, farmers use more local varieties, there is more sharecropping and they think that the following practices are good: early planting, drainage, stubble management, transplanting in row, crop management, and burning straw. The group 4 has the possibility of three cropping seasons, the supply of water is also rain fed, they are more diversified (maize, soybean, vegetables and beans), they use animal traction, they do not provide an opinion on burning straw, stubble management, early planting, drainage, they have a low level of knowledge of pests but they have a high gross income by hectare.

If these results are overlapped with the results of graph 2 and 3, it can be deduced that among the trained farmers, those who are represented in the 3rd quadrant can be associated to West Java and they might have a better understanding and use of IPM; on the other hand, those who are in the 4th quadrant are located in East Java, know about IPM and often apply the principles. Among the untrained farmers, the ones in the 1st quadrant are in East Java and they might be more concerned by the apparent higher total income and stability of income of the traditional system than by a cost benefit relation: they prefer to control systematically. Farmers in the 2nd quadrant are in West Java and might be more sensible to adopt IPM practices. The transmission of knowledge from FFS farmers to non FFS farmers in the latter region might be more important.

Conclusions

The analysis of the results shows that the differences between farmers are due to IPM training, which is a consequence of the program, and to location, which is a given (it existed before IPM/TP and it still exists after it). However the latter might imply that the message has to be adapted to each region in order to improve the response to the training.

Farmers Field Schools appear as a performing tool for IPM training and adoption. Besides, it seems to produce positive social externalities. However the lack of consideration in the agenda of the rational use of pesticides generates some problems in the case of pest outbreaks.

The impact appears to be limited to the public touched by the program and this might increase the gap between more receptive farmers and traditional ones. More attention should be given to the transfer aspects in the future.

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